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IS HELIUM USAGE A LAUGHING MATTER?

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Abstract: *Most people know helium from parties, when is used in inflating balloons or used to obtain a high voice, for laughing matter. In fact, these two ways of using this rare gas are the worst example, because, once released into the atmosphere it cannot or it can be very expensive to be recovered. Despite helium is the second most abundant element observed in the Universe, where the reserves constitutes about 23% of the mass, on Earth are limited and there are no many extraction plants. In this article are presented the main properties of this gas, ways of obtaining it, applications and some ways to prevent wasting.*

Key words: *helium, applications, recovery, prevent wasting.*

1. Historic Facts

In 1868 Janssen discovered how to observe solar prominences without an eclipse. While observing the solar eclipse of August 18, 1868, at Guntur, Madras State (now in Andhra Pradesh), British India, he noticed bright lines in the spectrum of the chromosphere, showing that the chromosphere is gaseous. Present in the spectrum of the Sun, though not immediately noticed or commented upon, was a bright yellow line later measured to have a wavelength of 587.49 nm. This was the first observation of this particular spectral line, and one possible source for it was an element not yet discovered on the earth. From the brightness of the spectral lines, Janssen realized that the chromospheric spectrum could be observed even without an eclipse, and he proceeded to do so.

On 20 October of the same year, Joseph Norman Lockyer in England set up a new, relatively powerful spectroscope. He also observed the emission spectrum of the chromosphere, including the same yellow line.

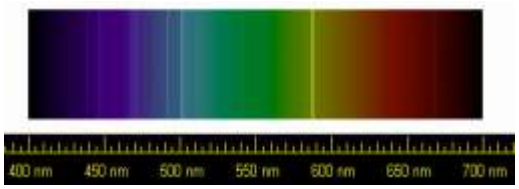

Fig. 1. *Spectrum of the solar chromosphere*

Within a few years, he worked with a chemist and they concluded that it could be caused by an unknown element, after unsuccessfully testing to see if it were some new type of hydrogen. This was the first time a chemical element was discovered on an extraterrestrial body before being found on the earth. Lockyer and the English chemist Edward Frankland named the element with the Greek word for the Sun, ἥλιος (helios) [1].

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2. Helium on Earth

The helium that is present on Earth is not a primordial component of the Earth but has been generated by radioactive decay. Helium does not accumulate in large quantities in the atmosphere because Earth's gravity is not sufficient to prevent its gradual escape into space.

Consequently, the occurrence of helium on the Earth is just a result of dynamic equilibrium between the generation and the escape. This is why helium is a really RARE GAS.

Helium-4 has two liquid forms. The normal liquid form is called helium I and exists at temperatures from its boiling point of 4.21 K (-268.9° C) down to about 2.18 K (-271° C). Below 2.18 K, helium-4 undergoes superfluidity (i.e., its viscosity, or resistance to flow, nearly vanishes) and its thermal conductivity becomes more than 1,000 times greater than that of copper. This liquid form is called helium II.

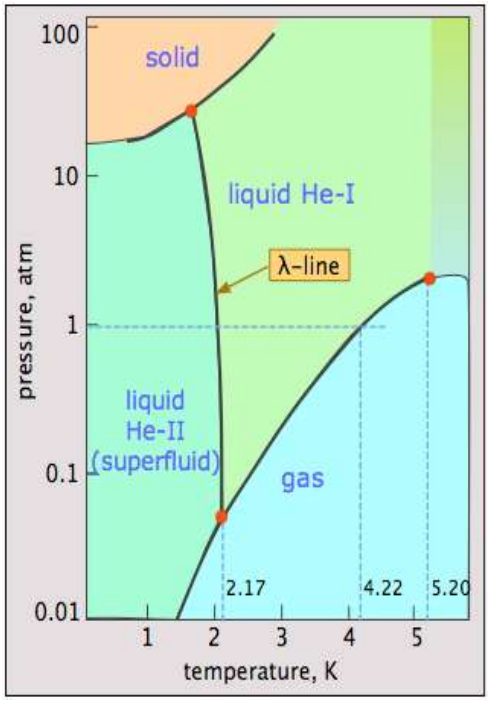

Fig. 2. *Phase diagram of ^4He*

Helium is an important industrial gas today, with unique properties, which makes it irreplaceable in many processes and the resources are of strategic importance.

Helium world consumption is 75 tonne/day which is equal to 27000 tonne/year and most of it is recovered from natural gas (NG) [2].

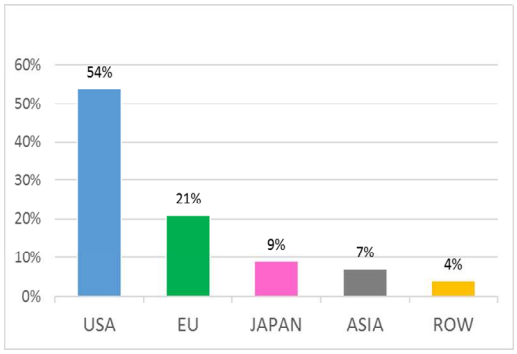

Fig. 3. *Helium world consumption by region [2]*

Global resources are limited and consumption is growing, which initiated administrative actions for to prevent wasting. Worldwide there are only 14 industrial helium plants, 8 in USA, 2 in Algeria, 2 in Qatar, 1 in Russia and 1 in Poland.

3. Helium Applications [3]

Aerospace & Aircraft

Because is a safe, inert gas, helium is widely used in aerospace and aircraft industry to do leak tests, for gases such as oxygen and hydrogen.

In space flight operations, helium is used to purge hydrogen systems and works as a pressurizing agent for ground and flight fluid systems. It is also a source of lift in

weather and other surveillance balloons.

Automotive & Transportation Equipment

Helium is used to test critical automotive parts such as radiator heat exchangers, air conditioning components, fuel tanks and torque converters to ensure they meet quality specifications. It is also used in combination with argon as a source of inflation in a growing number of airbags.

Diving

In combination with oxygen, helium is used in diving to help eliminate nitrogen narcosis, reduce breathing resistance at depth, and shorten decompression stops. Known as heliox, the mixture allows divers to reach greater depths for longer periods of time. The deeper the dive, the higher the concentration of helium, allowing divers to explore more and weld longer.

Electronics

Helium plays a significant role in the manufacturing of semiconductors, LCD panels, and fiber optic wire. It cools parts and components quickly to enhance throughput, controls the rate of heat transfer to improve productivity and reduce defects, and functions as a carrier gas in the production process.

Healthcare

Helium is used to achieve cryogenic temperatures of -451 degrees required for superconducting magnets in MRIs and NMRs, allowing the capture of high-resolution images of internal organs and tissues.

Welding & Metal Fabrication

Helium's inert properties at arc temperatures make it an ideal gas for welding materials with high heat conductivity such as aluminum, stainless steel, copper and magnesium alloys. Helium is also used in heat treating processes such as gas quenching and in furnace atmospheres to produce parts with higher tolerance and improved quality.

Other applications

Other important applications of helium are:

- ✓ for producing optical fibers used in telecommunication cables;
- ✓ in chemical processing, as a carrier gas, to facilitate analysis of a chemical substance's purity and composition through chromatography;
- ✓ to provide a protective atmosphere for growing germanium and silicon crystals for transistors and lasers, helium is used in semiconductor manufacturing;
- ✓ for various research and tests in university labs.

4. Helium Reserves

For the world, the total estimated reserves of 638 Bcf (Billion cubic feet, $1ft^3$=0,0283 m^3) divided by the current global helium refining rate of approximately 6.2 Bcf per year, indicates reserves should last about 100 years. However, if consumption continues to grow at recent rates (4 percent per year), these reserves fall to a less comfortable 40 years. Furthermore, it is important to note that this estimate is valid only if the entire amount of natural gas produced from each reservoir is processed for helium.

An improved assessment of the life of a country's reserves would require adjusting for the amount of helium that is bypassing helium-processing plants for that country - that is, gas that is being vented to the atmosphere never to be recovered.

To account for such losses would require obtaining, for each field with commercially available helium, information about the amount of natural gas produced from that field over a given period and the helium concentrations in that gas and then comparing the result to the amount of helium actually produced.

The ratio of helium extracted to the amount of helium withdrawn, extrapolated

to the amount of reserves estimated for the field, would provide an effective reserve for that field. [4]

Helium reserves Worldwide estimates are indicated in Table 1, presented bellow.

Estimates of Helium Reserves Worldwide, 2008 (billion cubic feet) [4] Table 1.

Country	Reserves[a]	Reserve base[a]
USA	153	350[b]
Algeria	64	300
Australia	NA	6,9[c]
Canada	NA	72
China	-	40
Indonesia	NA	14[c]
Poland	0,9	10
Qatar	360[d]	360
Russia	60	250
Other	NA	8,1
TOTAL	**638**	**1410**

NOTE: NA means not applicable, as the country has no refining capacity.

[a]Entries are those from USGS, 2009, unless otherwise specified and are current estimates based on available information. They are not certified by any accrediting institution.

[b]Includes measured and probable reserves rather than measured and indicated, as for other countries.

[c]Conservative estimates based on planned liquid helium plant capacity (see discussion in text) and a 25-year minimum plant productive life.

[d]According to information compiled by the DOE's Energy Information Administration, as discussed in the text.

5. Conclusions

This article discusses about helium, from historical facts through helium applications to helium reserves on Earth. Why this subject?

Helium is found in some gas mixtures like natural gas (NG) or some by-products of gaseous processes in concentrations 0,005 to 2%. The separation methods are high-tech and energy consuming, mostly cryogenic methods [2].

This subject because there is no replacement for liquid helium, and as shown, if consumption continues to grow at recent rates (4 percent per year), Earth Helium reserves fall to a less comfortable 40 years.

Global resources are limited and consumption is growing [2], so, more administrative actions to prevent wasting are needed.

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